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IS 7403 (1974): Code of practice for selection of standard worm and helical gear boxes [PGD 31: Bolts, Nuts and Fasteners Accessories]

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Indian Standard (Reaffirmed 2001)

CODE OF PRACTICE FOR SELECTION OF STANDARD WORM AND HELICAL GEAR BOXES

Gears Sectional Committee, EDC 59; Code of Practice for Selection of Gear Boxes Subcommittee, EDC 59 : 4 [Ref: Doc: EDC 59 (2088)]

1. Scope — This code has been prepared for the guidance of machinery manufacturers and users, to assist in selecting correct size of worm or helical gear boxes for the application and operating conditions involved.

2. Data for Proper Selection — The following data are essential to select correct type and size of worm and helical gear boxes.

2.1 *Prime Mover*

a) Type — Electric motor, steam engine or internal combustion engine (multi-cylinder or single-cylinder) ;

b) Rated power; and

c) Speed (if variable, indicate speed range and frequency of variation).

2.2 *Driven Machine*

a) Type — Such as kiln, conveyor, etc;

b) Actual power or torque necessary to drive the machine at desired speed;

c) Speed; and

d) Operating conditions, such as hours per day, whether continuous or intermittent, details of reversal, ambient temperature and any other special working conditions.

3. Service Factors — A gear box is rated to a specific application by the use of service factors. Service factor S is the ratio of maximum power rating of a particular size of gear box to the power required for driving the machine or equipment to which the gear box is coupled.

$$S = \frac{\text{Maximum rated power}}{\text{Actual power required}}$$

3.1 Each application has its own conditions and operating requirements, and Table 1 covers the list of service factors. In this list, the first column gives the type of prime mover, and the second column the duration of service. Columns 3 to 6 cover the numerical values of the service factors, divided into four classes, corresponding respectively, with an operation with uniform, moderate shock and heavy shock loads.

3.1.1 The service factors given in Table 1 are based on the assumption that the system is free from severe critical or torsional vibrations, and that the maximum momentary or starting loads do not exceed 200 percent of the normal load (100 percent overload).

4. Application Classification — The load characteristics of various machines and equipment in which reduction gear boxes are used, have been classified according to their operating conditions in Table 2. This table is intended as a guide to assist in deciding the appropriate service factor for a particular duty, and should be used in conjunction with service factors given in Table 1.

5. Basic Steps for Selection

5.1 *Determine Service Factor S* — The appropriate service factor for the application is determined by referring to Tables 1 and 2.

5.2 *Calculate Equivalent Power* — Equivalent power is equal to the actual power required for driving the machine at desired speed multiplied by service factor.

$$\text{Equivalent power} = \text{Actual power} \times S$$

5.3 *Determine Speed Ratio R* — This is obtained by dividing the speed of high speed shaft, ω_{HS} by the speed of low speed shaft ω_{LS}.

$$R = \frac{\omega_{HS}}{\omega_{LS}}$$

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5.4 *Select Size from Rating Table* — The rated power for the size of unit selected should be equal to, or greater than the calculated equivalent power for the given speed ratio of the gear box selected.

5.5 *Check for Momentary or Peak Load* — The gear box selected can take momentary loads of twice the rated power. However, in case the peak power requirements of the driven machine exceeds by more than 100 percent the rated power, the size selected should have rated power equal to or greater than half of the peak power. Momentary load means a load which acts for a period of not more than 15 seconds.

5.6 *Check Brake Torque* — When a motor or engine is equipped with brake, whose torque rating exceeds that of the motor or engine, the torque rating of gear box selected should exceed brake torque, all other things being equal.

5.7 *Check Overhung Load* — If a sprocket, pulley or spur pinion is mounted on the output shaft, overhung load is imposed on the shaft. The equivalent overhung load in kg is calculated as under:

$$P = \frac{A \times 975\,000 \times K}{N \times R}$$

where

P = equivalent overhung load in kg;
A = actual power carried by the shaft in kW;
K = load factor;
N = shaft speed in rpm; and
R = pitch radius of sprocket, pulley or spur pinion in mm.

The load factors are as under:

Overhung Member	*K*
Sprocket	1·00
Spur pinion	1·25
V-belt sheave	1·50
Flat belt pulley	3·00

5.8 The calculated overhung loads should be less than the maximum permissible overhung loads on gear boxes.

TABLE 1 SERVICE FACTORS

(*Clauses* 3.1.1, 4 *and* 5.1)

Prime Mover	**Duration of Service Hours/Day**	**Service Factors**			
		Nature of Load on Gear Unit from Driven Machine			
		Uniform	Moderate Shock	Heavy Shock Worm	Heavy Shock, Helical and Spur
(1)	(2)	(3)	(4)	(5)	(6)
Electric motor or steam turbine	2	0·75	0·9	1·25	1·40
	4	0·8	1·0	1·3	1·5
	8	0·9	1·1	1·45	1·65
	12	1·00	1·25	1·55	1·75
	24	1·25	1·5	1·75	2·00
Multi-cylinder internal combustion engine	2	0·9	1·1	1·25	1·65
	4	1·0	1·25	1·4	1·75
	8	1·1	1·35	1·6	1·90
	12	1·25	1·5	1·75	2·00
	24	1·5	1·75	2·00	2·25
Single-cylinder internal combustion engine	2	1·1	1·35	1·75	1·90
	4	1·25	1·5	1·85	2·00
	8	1·35	1·65	1·95	2·15
	12	1·5	1·75	2·05	2·25
	24	1·75	2·0	2·25	2·50

TABLE 2 LOAD CHARACTERISTICS VALUES FOR DIFFERENT APPLICATIONS

(*Clauses* 4 *and* 5.1)

U = Uniform Load
M = Moderate Shock Load
H = Heavy Shock Load
HI = High Inertia Load. Manufacturer to be consulted.

Driven Machine	Type of Load
Agitators:	
Pure liquids	U
Liquids and solids	M
Liquids — variable density	M
Blowers:	
Centrifugal	U
Lobe	M
Vane	U
Brewing and distilling:	
Bottling machinery	U
Brew kettles — continuous duty	U
Cookers — continuous duty	U
Mash tubes—continuous duty	U
Scale hopper—frequent starts	M
Can filling machines	U
Cane knives	M
Car dumpers	H
Car pullers	M
Clarifiers	U
Classifiers	M
Clay working machinery:	
Brick press	H
Briquette machine	H
Clay working machinery	M
Pug mill	M
Compressors:	
Centrifugal	U
Lobe	M
Reciprocating multi-cylinder	M
Single-cylinder	H
Conveyors—uniformly Loaded or fed:	
Apron	U
Assembly	U
Belt	U
Bucket	U
Chain	U
Flight	U
Oven	U
Screw	U
Conveyors—heavy duty not uniformly fed:	
Apron	M
Assembly	M
Belt	M
Bucket	M
Chain	M
Flight	M
Live roll	HI
Oven	M
Reciprocating	H
Screw	M
Shaker	H
Cranes:	
Main hoists	U
Bridge travel	HI
Trolley travel	HI
Crusher:	
Ore	H
Stone	H
Sugar	M
Dredges:	
Cable reels	M
Conveyors	M
Cutter head drives	H
Jig drives	H
Manoeuvering winches	M
Pumps	M
Screen drive	H
Stackers	M
Utility winches	M
Dry dock cranes:	
Main hoist	M
Auxiliary hoist	M
Boom, luffing	M
Rotating swing or slew	M
Tracking, drive wheels	H
Elevators:	
Bucket—uniform load	U
Bucket—heavy load	M
Centrifugal discharge	U
Bucket continuous	U
Escalators	U
Freight	M
Gravity discharge	U
Man lifts	HI
Passenger lifts	HI
Fans:	
Centrifugal	U
Induced draft	M
Large—mine, etc	U
Large—industrial	M
Light—smaller diameter	U
Feeders:	
Apron	M
Belt	M
Disc	U
Reciprocating	H
Screw	M
Food industry:	
Beef slicer	M
Cereal cooker	U
Dough mixer	M
Meat grinders	M
Generators — hot welding	U
Hammer mills	H
Hoists:	
Heavy duty	H
Medium duty	M
Skip	M
Laundry washers reversing	M
Laundry tumblers	M
Line shafts:	
Driving processing equipment	M
Light	U
Other line shafts	U
Lumber industry:	
Barkers—hydraulic-mechanical	M
Burner conveyor	M
Chain saw and drag saw	H
Chain transfer	H
Craneway transfer	H
De-barking drum	H
Edger feed	M
Gang feed	M
Green chain	M
Live rolls	H
Log deck	H
Log haul—incline	H
Log haul—well type	H
Log turning device	H

(Continued)

TABLE 2 LOAD CHARACTERISTICS VALUES FOR DIFFERENT APPLICATIONS—*Contd*

Driven Machine	Type of Load
Main log conveyor	H
Off bearing rolls	M
Planer feed chains	M
Planer floor chains	M
Planer tilting hoist	M
Re-saw merry-go-round conveyor	M
Roll cases	H
Slab conveyor	H
Small waste conveyor-belt	U
Small waste conveyor-chain	M
Sorting table	M
Tipple hoist conveyor	M
Tipple hoist drive	M
Transfer conveyors	M
Transfer rolls	M
Tray drive	M
Trimmer feed	M
Waste conveyor	M
Machine tools:	
Bending roll	M
Punch press—gear driven	H
Notching press—belt driven	HI
Plate planers	H
Tapping machine	H
Other machine tools and main drive	M
Auxiliary drives	U
Metal mills:	
Draw bench carriage and main drive	M
Pinch, dryer and slitters	M
Table conveyors non-reversing group drives	H
Wire drawing and flattening machine	M
Wire winding machine	M
Reversing	HI
Mills—rotary type:	
Ball	M
Cement kilns	M
Dryers and coolers	M
Kilns—other than cement	M
Pebble	M
Rod:	
Plain	M
Wedge bar	M
Tumbling barrels	H
Mixers:	
Concrete mixers—continuous	M
Intermittent	M
Constant density	U
Variable density	M
Oil industry:	
Chillers	M
Paraffin filter press	M
Rotary kilns	M
Paper mills:	
Agitators (mixers)	M
Barker—auxiliaries-hydraulic	M
Barker—mechanical	M
Barking drum	H
Beater and pulper	M
Bleacher	U
Calendars	M
Calendars, super	H
Converting machine, except cutters-platers	M
Conveyors	U
Couch	H
Cutters-platers	H
Cylinders	M
Dryers	M
Felt stretcher	M
Felt whipper	H
Jordans	H
Log haul	H
Presses	U
Pulp machine reel	M
Stock chest	M
Suction role	U
Washers and thickeners	M
Winders	U
Printing presses	HI
Pullers:	
Barge haul	H
Pumps:	
Centrifugal	U
Proportioning	M
Reciprocating:	
Single acting, 3 or more cylinders	M
Double acting, 2 or more cylinders	M
Single acting, 1 or 2 cylinders	HI
Rotary	
Gear type	U
Lobe, vane	U
Rubber and plastics industries:	
Crackers	H
Laboratory equipment	M
Mixing mills	H
Refiners	M
Rubber calenders	M
Rubber mill—2 on line	M
Rubber mill—3 on line	U
Sheeter	M
Tubers and strainers	M
Warming mills	M
Sand muller	M
Sewage disposal equipment:	
Bar screens	U
Chemical feeders	U
Collectors	U
Dewatering screws	M
Scum breakers	M
Slow or rapid mixers	M
Thickeners	M
Vacuum filters	M
Screens:	
Air washing	U
Rotary—stone or gravel	M
Travelling water intake	U
Slab pushers	M
Stockers	U
Sugar industry:	
Cane knives	M
Crushers	M
Mills	M
Textile industry:	
Batchers	M
Calendars	M
Cards	M
Dry cans	M
Dryers	M
Dyeing machinery	M
Looms	M
Mangles	M
Nappers	M
Pads	M
Slashers	M
Soaps	M
Spinners	M
Tenter frames	M
Washers	M
Winders	M
Windlass	HI